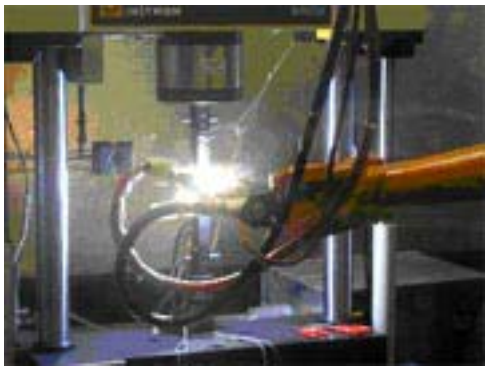
Plasma Torch Test Bed Facility

Purpose:

To enable relative performance characterization of ablative materials by exposing them to conditions similar to the internal environment of a rocket motor.

Ablative materials are commonly used in rocket systems for components exposed to extremely high heat environments, such as Space Shuttle Super Light Weight Tank (SLWT) nose caps, and Reusable Solid Rocket Motor (RSRM) nozzle liners and case insulation. The Plasma Torch Test Bed (PTTB) facility provides an inexpensive rapid turnaround test that is well characterized and may be used to accurately predict material performance in service environments.



Ablative materials are sacrificially lost while expending incident thermal energy in a self-regulating heat and mass transfer process. The level of performance of an ablative material in a given environment is generally indicated by (1) the amount of material lost (or eroded), and (2) the amount of remaining material that has been thermally affected (or charred). Inside a solid rocket motor, impingement of particles from the burning propellant may induce additional mechanical erosion, thus increasing the total rates.

The PTTB employs a supersonic plasma jet to induce a very high level of heat flux on the surface of a material specimen, which results in erosion and charring. A particle feeder may be used to introduce particles into the plasma plume, resulting in high velocity impingement of molten particles on the specimen surface. Testing of different materials exposed to the same heat flux and particle impingement levels provides an indication of their relative performance and may be used for candidate screening.

Recent statistically designed experiments conducted on RSRM case insulation materials indicate that the PTTB is capable of replicating the dissimilar performance of a specific material pair exposed to the same environment, as observed in full scale testing. No other sub-scale test bed has reproduced this discrimination.

Other material phenomenon, such as pocketing (sudden ejection of material fragments from the surface due to heat induced internal pressurization) may be exhibited in the PTTB as well. Screening tests at conservative (higher than service) heat flux levels may be implemented on representative samples to assure that a lot or batch of material does not exhibit an unacceptable tendency toward such phenomenon.

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